



Teachers Guide for *Fuel Cells: Green Power*

Overview

Although not developed specifically for classroom use, *Fuel Cells: Green Power*, a publication sponsored by the U.S. Department of Energy (DOE) through Los Alamos National Laboratory (LANL), has been used to introduce fuel cell technology to teachers and students all over the world (in response to user requests, Spanish and German versions are now available). It provides a brief history of fuel cells; describes the different types of fuel cells, their applications, and how they work; and explains the benefits of fuel cell use.

Classroom Integration and Follow-up Ideas

1. Classroom discussion topics

- a.) Why are fuel cells such a promising new technology? Have students discuss how fuel cells could be introduced. What will the future look like if we use fuel cells in our everyday lives—how will that future differ from our world today?

Teacher's note: The discussion should include the benefits of using hydrogen in fuel cells in addition to the benefits of using fuel cells rather than conventional power systems.

- b.) What are future applications for fuel cells? Have students discuss what they feel would be the most cost-effective first uses of fuel cells. Ask the class to brainstorm and then research why it is more expensive to use fuel cells in a car than a computer.
- c.) What are the challenges to fuel cell commercialization – for all applications?
- d.) What might the hydrogen infrastructure, which will deliver hydrogen to end-users, look like?

Teacher's note: Students should consider various hydrogen production technologies and how they could differ from region to region (based on available resources).

- e.) What would be the best ways to inform the public about emerging hydrogen and fuel cell technologies? What are the benefits of demonstration projects (such as Chicago fuel cell bus project) that use fuel cells and hydrogen? (See project #3 below for additional follow-up).

2. Research topics

- a.) The Hindenburg disaster – what really happened? How could the Hindenburg tragedy affect the future commercialization of hydrogen and fuel cell technology and how can we overcome this challenge?
- b.) Research the evolution of energy use, beginning with fuels with high carbon content, such as wood, to other forms of energy with less carbon content, such as hydrogen. Compare and contrast the development of fossil fuels with renewable forms of energy.

- c.) What are the different ways in which hydrogen can be produced and what are the advantages and disadvantages of each production method?
- d.) How are fuel cells different from batteries, internal combustion engines, oil-powered home furnaces, and other forms of energy production?
- e.) Compare and contrast the safety and environmental characteristics of today's fuels with hydrogen.
- f.) The United States uses about 20 million barrels of oil per day, at a cost of about \$2 billion a week. Much of this is used to power highway vehicles. How can the introduction of fuel cells into the transportation sector help to increase fuel efficiency and decrease foreign oil dependency?

3. Public Service Campaign

Ask students to imagine they work for a public relations firm that has been tasked with educating the public about emerging fuel cell technology. Discuss various audiences, their needs, and the issues that an education campaign should address (such as safety and technology benefits). The class can work in groups to design appropriate campaigns for a variety of audiences, such as homeowners, students, state and local governments, other potential “early-adopters” or users of the technology, and any other group students think is appropriate. Campaigns could include print, TV, radio, billboards, etc.

Teacher's note: Students should understand the importance of timing – and create a timeline for their campaigns that considers market-readiness so as not to mislead their audiences about the availability of the technology.

4. Re- design your school for sustainable energy

Have students develop a plan to retro-fit their school using hydrogen and fuel cell technology. They should consider hydrogen production, delivery, and storage; various fuel cell applications; safety issues; and education needs.

5. Career Options

Have students research their career options related to hydrogen and fuel cell technology and map the pathways to those careers.

We want to hear from you! If you have ideas or suggestions for ways to incorporate hydrogen and fuel cells into your classroom activities, or if you'd like to provide feedback on the integration activities described on this handout, please contact Christy Cooper at 202-586-1885 or christy.cooper@ee.doe.gov

For more information about hydrogen and fuel cells – including links to a variety of on-line information resources, please visit the Hydrogen, Fuel Cells, and Infrastructure Technologies Program web site, <http://www.eere.energy.gov/hydrogenandfuelcells>

